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Chapter 6. Wholesale Competition

1. Introduction

The previous chapter reviewed the information relevant to the grid's support of wholesale markets. This Chapter considers the information available to determine whether wholesale markets are competitive. Competitive markets are desirable because they promote efficient resource allocation.[1] The Federal Government is responsible for approving utility mergers and enforcing anti-trust law as well as wire fraud and conspiracy statutes incident to recent prosecutions for electricity market manipulation.

Somewhat surprisingly, competitive wholesale electricity prices are also necessary for properly valuing congestion revenues and, therefore, signaling transmission investment and new generator location. Congestion can be reduced by investments in transmission capability and by locating new generators to relieve bottlenecks. When energy prices are competitive, the transmission price (difference in energy price at either end of a line) is the marginal benefit (savings) from relieving congestion. Consequently, when wholesale prices are competitive the congestion charge is appropriate for signaling the (marginal) need for investment and for guiding the location of new generation.

Section 2 presents conventional statistics that have been accepted by Federal courts for describing competitive markets. Section 3 presents the data for gauging wholesale competition and Section 4 describes how the identified data gaps might be filled.

2. Measures of Wholesale Competition

Competitive markets are characterized by a large number of suppliers vying to sell to a large number of informed customers. When there are many buyers and sellers, each of which is small relative to the market, no one has significant power over price. The market price is one that causes demand to equal supply. In competitive markets, price just equals the cost of producing the last unit sent to market, i.e., price equals marginal cost. Price also equals the marginal benefit received by the last customer willing to make a purchase. A supplier has market power when he can sustain price significantly above marginal cost.

***Number of competitors, concentration ratios and new entry*:** The number of firms serving a regional market, their market shares and market share indices, especially the Herfindahl-Hirschman Index (HHI), are well-established indicators of a competitive

[1] Efficient in the sense that a competitive wholesale power market would minimize the social cost of meeting consumers' electricity demands and those demands would reflect the value to them of consuming electricity compared to other goods. Stated differently, competition has the potential to maximize the net benefit from electricity consumption less the costs of its production and delivery.

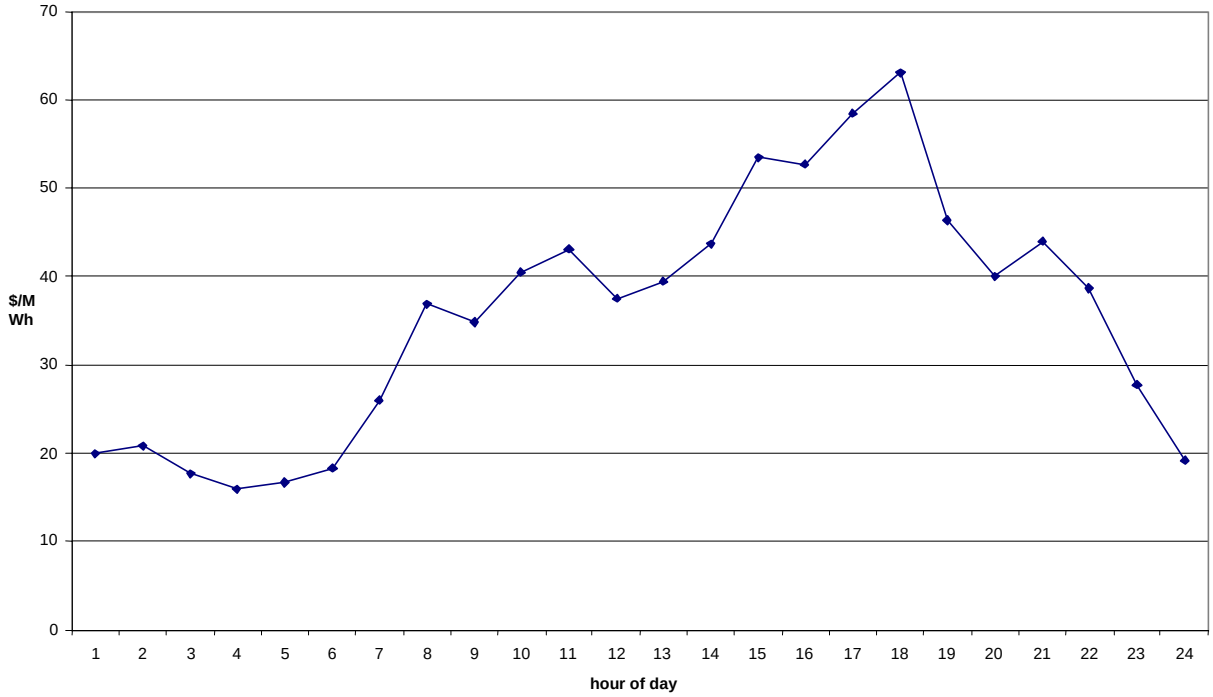
industry.[2] This measure assumes that he relevant market can be identified. Thee difficult problem in calculating market shares and HHI s is electricity market boundaries are not obvious: establishing boundaries generally requires electrical models. As discussed in Chapters 3 and 5 the Federal Government does not maintain reference electrical models sufficient for delineating regional markets.

While the courts pay attention to the HHI they also consider many other factors before concluding that a firm is exercising market power.

***Price compared to marginal cost*:** Market price compared to marginal cost is a litmus test for competition: wholesale price sustained above the marginal cost of the last generator dispatched can indicate market power. This comparison is called the Lerner index. The index is variously calculated as the ratio of price to marginal cost or the percent markup over marginal cost or the markup as a percent of price. Accurately estimating and interpreting the Lerner index is often a challenge.

To make a valid comparison, reference prices and marginal costs must refer to the same time. This is important in electricity because prices vary greatly during the day. PJM's hourly prices are illustrative of the magnitude of price variation.

Figure 6-1. Average hourly wholesale price in PJM on July 16, 2002



Source: Data from www.pjm.com , markets, energy, real time, monthly real-time LMP, file 200207-rt.csv, load weighted average prices

[2] See U.S. Department of Justice, 1992 Horizontal Merger Guidelines (with April 8, 1997, Revisions to Section 4 on Efficiencies), Section 1. Market Definitions, Measurement and Concentration.

Accurate estimates of marginal cost are also critical to the results. As pointed out by Timothy Brennan, many market power studies have used average variable cost rather than true marginal cost. That would overstate the extent of market power and might persuade regulators to enforce artificially low price ceilings. [3]

Selecting the right marginal cost to use in the Lerner index also requires care. When transmission is unconstrained, the available generators are ranked in order of their marginal costs from least to most costly. The marginal cost of the *last* generator needed to meet demand is the relevant marginal cost in the Lerner comparison.[4]

In fact the transmission grid is at times congested-power cannot be delivered as desired. PJM again provides an example. When the system is congested, generators are recruited out-of-merit-order to stay within security limits (see Chapter 3 for a discussion of security limits). A congested system breaks into sub-markets, all operating at the same time. Sorting out which generator's marginal costs to pair with observed locational prices requires both an electrical model and information on how much and where demand is located.

Table 5-1. Congested Hours (Real Time) in PJM, 2002

Month	Hours Congested	Month	Hours Congested
January	245	July	505
February	79	August	540
March	120	September	595
April	263	October	540
May	596	November	533
June	664	December	550

Source: PJM, Figure A-15, Page 165, State of the Market Report

Areas that routinely find themselves in high priced sub-markets are called load pockets. Since these areas have limited recourse to outside suppliers, generators within the load pocket are well placed to increase price well above marginal cost.

Withholding and Manipulation of transmission markets: Concentration ratios and Lerner indices shed little light on how market participants can sustain artificially high

[3] Brennan, Timothy J., Mismeasuring Electricity Market Power, Regulation, Spring 2003, pages 60-65.

[4] It can happen that market demand is met at exactly the maximum capacity of the most expensive generator. In that case a competitive price is consistent with any marginal cost between that of the last generator recruited and that of the generator required to meet any small additional demand. See Stoft, Steven, *Power System Economics*, IEEE Press, Wiley Inter-Interscience, 2002 for a detailed discussion of these issues. For the Lerner test to give the right answer, all generators able and economic to run at the time the comparison is made must be available for dispatch. If relatively cheap generators were in fact withheld from the market, price would equal marginal cost, but market prices would be above the competitive level.

prices. They do not account for the kinds of capacity withholding and grid manipulation that FERC has observed in electricity markets. [5] Withholding appears to have been one way that generators were able to increase price during California's crisis. FERC sees withholding as sufficiently important that it has developed a pivotal supplier test.[6] This test attempts to identify generators whose absence would be enough to significantly increase price. The data needed to calculate Lerner indices is adequate to identify pivotal suppliers.

Enron showed how generators might take advantage of market rules to manipulate transmission markets and increase their profits. To the extent gaming impacts prices the Lerner index may indicate something is amiss. The Lerner index would not detect strategies that only shift profits.

Joskow and Tirole make a more subtle point about the ownership of financial transmission rights (congestion revenue rights). Holders of these rights are paid the congestion revenues associated with the constrained lines their rights cover.[7] They conclude "The possession of financial rights by a producer in the importing region or by a consumer in the exporting region aggravates their market power, since financial rights give them an extra incentive to curtail their output or demand to make the rights more valuable."[8] Consequently in those areas that use congestion rights, data on their ownership could be important.

Limits on market power: Firms with market power do not have an unlimited ability to charge what they will. New entry and its threat are disciplines to market power in many industries. To the extent new competitors can enter quickly at low cost, incumbent firms are dissuaded from exercising market power. If competitors actually enter in response to high prices, they will diminish the price making power of incumbents.

In most industries price increases lead to demand reductions. If pronounced, demand reductions limit how much suppliers can profitably charge. There is presently a very limited degree of demand response to the price of electricity. Essentially all retail customers face fixed prices. Consequently when demand approaches the limits of supply, generators could, absent regulatory intervention, raise price without fear of losing sales. Currently regulatory pressure is more effective in disciplining prices than is demand response.

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[5] See, for example, FERC Staff Report, *Final Report on Price Manipulation in Western Markets, Fact-Finding Investigation of Potential Manipulation of Electric and Natural Gas Prices*, Docket No. PA02-2-000, March 2003.

[6] The test amounts to hypothetically removing some or all of a generator's capacity from the market supply. If that would cause price to increase much above the competitive level, that generator is said to be pivotal

[7] The congestion revenues are the difference of the prices at the receiving and sending location times the flow guaranteed by the right. When prices are the same at both locations, there are no congestion revenues.

[8] Paul Joskow and Tirole, J, *Transmission rights and market power on electric power networks*, the Rand Journal of Economics, Vol. 31, No. 3, Autumn 2000, page475

The "natural" limits to market power in electricity are limited. And, the grid provides some generators with protection from competition. Both considerations suggest market prices may be above competitive prices, at least when supplies are short.

3. Data on wholesale competition

This section discusses the official data available to detect and assess market power.

Number of firms and concentration ratios: Between FERC and EIA, the Federal Government has a complete list of the larger generators, their capacity, annual production and their ownership. The Form EIA-860 is the source of periodic reports: Inventory of Electric Utility Power Plants in the United States and its companion Inventory of Non-Utility Power Plants in the United States. The coverage of small generators, especially co-generators, is less complete. Given market boundaries official data is adequate to identify the competitors and their capacities. EIA also collects data on individual generator output and heat rates. That data allows calculation of market concentration ratios and the fuel portion of costs. However, individual generator output and heat rate data are not publicly available.

Price compared to marginal cost: These comparisons are a basic test of market competition. As explained above these comparisons require market prices and quantities, net trade flow, good estimates of marginal cost and, when the grid is congested, an electrical model.

The ISO's have complete market prices, quantities, trade flows, offers to buy and sell and knowledge of operable units.[9] They can also have much of the detailed knowledge necessary to estimate marginal cost. Thus ISOs or their market monitors are in a good position to properly compute and interpret Lerner indices. [10]

PJM has released estimates of the Lerner index for its system. PJM reports the markup over price.[11] In addition to having complete data on generator availability and production, generator offers, demand volumes and locations and valid electrical models, PJM also had cost data on all units whose construction started before July 9, 1996.[12] PJM calculated the Lerner index for every five-minute interval and they accounted for congestion. PJM has not released the underlying data and models that would be necessary to replicate their results.

PJM reports two estimates of the average markup as a percent of price. The first, called the adjusted markup, assumes that their marginal cost estimates are precise. The resulting

[9] The market prices that ISOs report are, on occasion, "mitigated": the ISO rejects the original market price and replaces it with the mitigated price when the ISO concludes the former is exorbitant.

[10] Independent researchers have made similar calculations using price data from ISOs. See, for example, Borenstein, Severin, Bushnell, James and Wolak, Frank, Measuring Market Imperfections in California's Restructured Wholesale Electricity Market, University of California Energy Institute, CSEM WP102, June 2002

[11] (market price-marginal cost)/market price).

[12] PJM, 2002 State of the Market, page 28.

index averaged 11% for 2002, with a maximum of 13% in July and a minimum of 10%. PJM also calculated the index on the assumption that their estimates do not include all relevant costs. They increased their marginal cost estimates by 10% presumably to cover such hard to measure things as variable operations and maintenance costs. The result is to lower the average markup to 2% in 2002, with a maximum of 4% in July and a minimum of 1%.[13]

PJM interprets these results as:

> "…the data on the price-cost markup are consistent with the conclusion that the energy market was reasonably competitive in 2002 although the evidence is not dispositive."[14]

Official data for areas outside of the ISOs is far less precise. EIA collects but does not publicly release generator fuel costs, heat rates and similar information for estimating marginal cost on the EIA-860 and EIA-423. Fuel costs are monthly and heat rates tend to be long-term averages. Since a generator's heat rate varies a great deal depending on utilization, and its operating regime (start-up, shut down, etc.) marginal costs estimates based on that data are likely to be imprecise approximations of hourly marginal costs. Hourly generation data from fossil fueled and hydroelectric facilities (pumped storage) are not available from EIA.

In comparing price to the marginal cost of serving the wholesale market, it is necessary to know which generators were available at the time the comparison wholesale prices were observed. The Environmental Protection Agency's Continuous Emissions Monitoring System records hourly emissions and, sometimes, hourly output from fossil fueled generators. The absence of emissions is an indicator that a particular plant is not operating.

Outside of the ISOs, there are no official hourly market prices. There are commercially available prices at a few "hubs". How closely these prices approximate market prices is controversial.

If market data were to show multiple prices, it would be necessary to have an accurate electrical model to determine whether the differences reflect congestion or something else. As mentioned previously, the Federal government does not maintain such models.

Outside of the ISOs, official data does not support firm conclusions about the presence or absence of competitive wholesale markets.

Entry: Chapter 4 showed that the Federal Government has complete data on the connection of larger generators to the grid. A large number of independent generators have entered the market since 1999. Official data says little about the costs and time lags

[13] PJM, 2002 State of the Market, page 28.

[14] PJM, 2002 State of the Market, page 5.

associated with entry. And official access data is not archived in a form that allows statistical analysis of access availability and the quality of service.

Demand-Price Response: The Federal Government collects no data on the amount of consumption that is metered for price response. Nor does it routinely collect data on consumer participation and behavior in price responsive demand programs. The ISOs periodically release information about their programs. Such data as exists show demand response is miniscule.

The New England ISO, for example, reports the number of customers signed up for each program and the available megawatts for response on its web site,

> "As of November 1, 2002 there were 248 customers signed up for the load response program providing 195.615 MWs of possible load relief. There are 122.494 MWs in the Class 1 Program and 73.121 MWs in the Class 2 Program."[15]

The total possible load relief is only seven tenths of one percent of New England's installed capacity in 2000.[16]

Similarly, PJM's State of the Market Report finds:[17]

> "The maximum hourly reduction in load that resulted from PJM programs was 1,833 MWh in 2002."[18]

This compares with a maximum daily peak demand of 63,762 MW in 2002.

Demand response is not a counterweight to market power at this time.

4. Filling the Information Gaps

Outside of the ISOs the government does not have the data necessary to monitor and evaluate the competitive status of wholesale markets. Government can subpoena data in response to clear behavioral evidence of anti-competitive behavior or as part of a merger approval. But the subpoena is not a reasonable means of obtaining data for market monitoring.

If Federal regulators and anti-trust officials are satisfied with market share analyses, then the critical need is for high quality power flow models and associated data described in Chapter 3. That information is required to delineate market boundaries.

If Federal regulators and anti-trust officials require Lerner indices for non-ISO areas, much more data than is currently available would be needed. Critical missing data are high frequency wholesale price, generator output and availability, and demand, net of power inflows. High frequency, market specific wholesale price data would require new collections.

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[15] http://www.iso-ne.com/Load_Response/main.html January 22, 2003.

[16] EIA, Electric Power Annual 2000, Volume II, Table 3, New England installed capability, page 4.

[17] PJM Interconnection, L.L.C. "Load Response Programs 2002 Statistics Estimated for 6/26/02 to 12/1/02".

[18] PJM, 2002 State of the Market, page 37

Hourly generation from fossil fueled units would be available if EPA were to require (rather than just encourage) generators to report actual generation injected into the grid on the Continuous Emission Monitoring System (CEMS). But CEMS does apply to generation from nuclear units, hydropower (including pumped storage), wind, solar, and geothermal units. Hourly generation data for nuclear and federal hydropower exists, but is not readily available. Utilities and IPPs have production data for the other sources, but neither EIA nor FERC currently collect it. NERC maintains extensive data on generator availability.

Demand by control region is reported hourly on the FERC 714. As noted in Chapter 3 that data are not disaggregated to individual buses, reporting is incomplete and the data from different reporters is contradictory. Hourly net power inflows are not reported, so net demand cannot be calculated.

By contrast, the ISOs have all the data required to delineate markets within their areas and to compute concentration ratios and Lerner indices.[19] FERC has the power to require that ISO data necessary to gauge competition be made routinely available to government policy makers and analysts. To date, FERC has not made such a requirement.

As mentioned in Chapter 3 information on demand response to prices could be obtained by adding a new schedule to the EIA 861. The required information would include potential MW metered to record hourly (or higher frequency) consumption and MWh charged by time of consumption.

[19] In the event these statistics indicate non-competitive pricing, special purpose data collections could be employed to determine how (withholding, manipulation of transmission markets, etc.) market participants are thwarting efficient pricing.